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(54) COOLING AIR SUPPLY FOR THE COOLING OF DIFFERENT SYSTEMS REQUIRING COOLING AIR IN AN AIRCRAFT

KÜHLLUFTZUFUHR ZUM KÜHLEN VON KÜHLLUFT ERFORDERNDEN VERSCHIEDENEN SYSTEMEN IN EINEM FLUGZEUG

SYSTEME D'ALIMENTATION D'AIR DE REFROIDISSEMENT DESTINE A REFROIDIR DIFFERENTS SYSTEMES NECESSITANT DE L'AIR DE REFROIDISSEMENT DANS UN AERONEF

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(73) Proprietor: **Airbus Deutschland GmbH**
21129 Hamburg (DE)

(72) Inventors:
- **SOLNTSEV, Alexander**
  22119 Hamburg (DE)
- **BAMMANN, Holger**
  21614 Buxtehude (DE)

(74) Representative: **Thum, Bernhard**
Wuesthoff & Wuesthoff
Patent- und Rechtsanwälte
Schweigerstrasse 2
81541 München (DE)

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Description

[0001] This invention relates to a cooling air supply system for an aircraft according to the preamble of claim 1.

[0002] In the field of aircraft construction, it is necessary to provide different functional units within the aircraft with cooling air. In the past, in order to meet the different requirements of the devices requiring cooling air within the aircraft, separate cooling air supply systems were provided adapted to each individual device requiring cooling air respectively. In this way, the individual devices requiring cooling air were supplied with sufficient quantities of cooling air, however this led to sophisticated cooling air supply systems, which all together significantly added to the weight of the aircraft, as well as associated high manufacture and maintenance costs. Moreover, several air inlets and air outlets had to be provided in the outer skin of the aircraft which weakened the aircraft structure and which led to relatively high additional air resistance (drag) of the aircraft. Finally, as a result of the different cooling air supply systems, a considerable amount of structural space within the aircraft interior was taken up.

[0003] US 2003/177780 A1 describes an air conditioning system having an air inlet, an air channel communicating with the air inlet and an air distribution device for the distribution of air to at least two devices requiring cooling air. However, the cooling air flows without any limitation to the devices requiring cooling air.

[0004] A similar system is also known from US 2002/1166923 A1.

[0005] In response to this, it is an object of this invention to provide a cooling air supply system of the type indicated above, which can be produced so as to avoid the disadvantages with regard to the current state of the art technology described above, with a high level of efficacy and at low cost.

[0006] This object is solved by a cooling air supply system for an aircraft according to claim 1.

[0007] This cooling air supply system supplies cooling air from the aircraft surroundings to at least two devices within the aircraft requiring cooling air, whereby the cooling air supply system has an air inlet, an air channel communicating with the air inlet and an air distribution device for the distribution of air to at least two devices requiring cooling air. With the cooling air supply system in accordance with the invention, an air inlet is also supplied which is designed in such a way that it covers the maximum cooling air requirement of the at least two devices requiring cooling air.

[0008] In accordance with the invention, therefore, the devices requiring cooling air can be supplied with cooling air by means of one and the same air inlet and by means of an integrated cooling air supply system. In this way, the disadvantages of the current state of the art technology, described above, and associated with the provision of several separate cooling air supply systems, can be effectively eliminated. In particular, by means of the integrated cooling air supply system in accordance with the invention, a large number of components are no longer required, and so there is a considerable reduction in the system weight of the cooling system. Due to the fact that just one air inlet is required, the additional air resistance of the aircraft (drag) can also be considerably reduced. In addition, it also means that there is less weakening of the aircraft structure than is the case with the state of technology described above. Finally, the cooling air supply system in accordance with the invention also offers advantages with regard to simpler installation and maintenance.

[0009] Another development of the cooling air supply system in accordance with the invention proposes that the air inlet is in the form of an NACA air inlet in an outer skin of the aircraft. As is known, an NACA (National Advisory Committee for Aeronautics) air inlet has relatively low air resistance with, at the same time, high air intake performance. In connection with this it should also be mentioned that the applicant has recognised that a larger NACA air inlet is more efficient that a number of smaller NACA air inlets, as used in the current state of the art technology for the different cooling air supply systems.

[0010] An advantageous further embodiment of the invention proposes that the air channel communicating with the air inlet has a diffuser. In the diffuser, the air entering through the ram air inlet at high speed is slowed down. In this way, the kinetic energy of the air entering through the ram air inlet at high speed is transformed into static energy and pressure recovery is achieved.

[0011] In order to be able to guarantee a sufficient supply of cooling air, even when an aircraft is on the ground, a further development of the invention proposes that at least one air compressor, preferably a ventilator, is provided in the diffuser or in one of the first bypass lines leading off of the diffuser. In this way, cooling air can be sucked from the air compressor via the diffuser and be supplied to the devices to be cooled. The air compressor can be electrically powered or be in the form of a turbocompressor.

[0012] In accordance with another development of the invention, a check valve is provided in the diffuser or in one of the second bypass lines leading off from the diffuser, and this blocks cooling air so that it does not flow back into the diffuser. Preferably the first bypass line and the second bypass line are arranged in parallel so that undesired flowing back of cooling air which was sucked in from the aircraft surroundings by the air compressor, can be prevented.

[0013] In accordance with the invention, it can also be arranged for a cooling air collection chamber to be connected to the diffuser, preferably following to the parallel arrangement point of the first and second bypass lines. Moreover, at least one cooling air supply line can be positioned between the cooling air collection chamber and each of the devices requiring cooling air. In order to be able to carry out distribution of cooling air which corre-

sponds to the devices requiring cooling air, the invention provides that the cooling air supply line is provided with a throttle device, preferably with a shutter. The throttle device can be variably adjustable. Alternatively, it is also possible to adapt the throttle device, especially the shutter, to the different devices requiring cooling air at the time of installation.

[0014] In accordance with the invention, the devices requiring cooling air can be the ventilation device for an unpressurized (pressure-free) air-conditioned space (Unpressurized Bay Ventilation; UBV) and/or an On Board Oxygen Generation System (OBOGS) and/or an On Board Inert Gas Generation System (OBIGGS). In connection with this and within the framework of advantageous further developments of the invention, it is also possible for the device requiring cooling air, in particular the on board oxygen generation system (OBOGS) and/or the on board inert gas generation system (OBIGGS) to have a heat exchanger which uses the cooling air in order to expel heat.

[0015] With regard to the cooling air output, there is a further development of the cooling air supply system in accordance with the invention which proposes that at least two, preferably all of the devices requiring cooling air are connected to a common cooling air outlet by means of expelled air pipes.

[0016] The invention also relates to an aircraft which is designed with a cooling air supply system of the type described above.

[0017] In the following, an example of this invention is described with reference to the attached figure in which a cooling air supply system 10 in accordance with the invention is schematically represented.

[0018] The cooling air supply system 10 in accordance with the invention includes an NACA air inlet 12 which is positioned in the outer skin of the aircraft 14. The NACA air inlet 12 leads to a diffuser 16, at the end of which are a line section 18 and a bypass channel 20 in the style of a parallel arrangement. In the line section 18 a check valve 22 is positioned, and this permits flow in the direction of the arrow 24, but blocks flow in the opposite direction. A turbo compressor 26 is provided in the bypass channel 20 which, when powered, also causes air to flow in the direction of the arrow 24.

[0019] A cooling air collection chamber 28 joins onto the line section 18. Several cooling air supply lines 30, 32 and 34 lead off of this.

[0020] During flight operations when the aircraft is at cruising altitude, ambient air at a temperature of approx. -50°C flows into the NACA air inlet 12 in accordance with the arrows P. The ambient air enters the diffuser 16 via the NACA air inlet 12 and flows through the check valve 22 into the collection chamber 28.

[0021] During ground operation, cooling air is conveyed via the diffuser 16 into the collection chamber 28 by means of the turbo compressor 26, whereby the check valve 22 prevents the cooling air from flowing back into the atmosphere.

[0022] The cooling air supply line 30 has a firmly installed shutter 36 close to its interface with the collection chamber 28, and this limits its flow cross-section. It leads to a supply system 38 by means of which the ventilation device of an unpressurized air-conditioned space (unpressurized bay ventilation; UBV) is supplied with cooling air in accordance with arrows 40 and 42.

[0023] The cooling air supply line 32 also has a firmly installed shutter 39 which limits its flow cross-section. It takes cooling air from the collection chamber 28 to a heat exchanger 44 which is assigned to an on board oxygen generation system (OBOGS). By means of the heat exchanger 44, a heated fluid conveyed in a line 46 of the on board oxygen generation system can expel heat into the cooling air. The heated cooling air is then led away from the heat exchanger 44 via an expelled air pipe 48, and taken into an air outlet pipe 50. The air output pipe 50 ends at an air outlet 52 which is also provided in the outer skin of the aircraft 14 and which opens into the aircraft surroundings.

[0024] The cooling air supply line 34 also has a shutter 54. It leads to another heat exchanger 56 which is assigned to an on board inert gas generation system (OBIGGS). By means of the heat exchanger 56, heated fluid conveyed by a line 58 of the on board inert gas generation system (OBIGGS) can be cooled, and its heat can be expelled into the cooling air flowing through the heat exchanger 56. The heated cooling air which comes out of the heat exchanger 56 is then taken via an expelled air pipe 60 into the air output pipe 50 and can exit into the atmosphere by means of the common air outlet 52.

[0025] The invention makes it possible to provide a cooling air supply system which only requires one single air inlet and one single air outlet and yet still provides sufficient cooling air in order to supply a number of different devices requiring cooling air with a sufficient amount of cooling air. This means that the disadvantages, as described at the start with reference to the current state of technology, can be avoided. In particular, the cooling air supply system in accordance with the invention can be of relatively low system weight. Moreover, the cooling air supply system in accordance with the invention leads to just a slight increase in the air resistance of the aircraft and to an insignificant weakening of the aircraft structure due to the fact that it only has one single air inlet and one single air outlet. Due to the simplified design of the system in accordance with the invention, it can be produced cheaply, and can be installed more easily and at a low cost.

Claims

1. Cooling air supply system (10) for an aircraft for the supply of cooling air from the aircraft surrounds to at least two devices requiring cooling air (38, 44, 56) within the aircraft, with an air inlet (12), an air channel (16) communicating with the air inlet (12) and an air

distribution device (30, 32, 34) with at least one cooling air supply line (30, 32, 34) for each of the at least two devices requiring cooling air for the distribution of air to the at least two devices requiring cooling air (38, 44, 56), whereby the air inlet (12) is proportioned in such a way, that it covers the maximum cooling air requirement of at least two devices requiring cooling air (38, 44, 56),
characterized in that the cooling air supply line (30, 32, 34) is provided with a throttle device (36, 39, 54).

2. Cooling air supply system (10) in accordance with claim 1,
characterized in that the air inlet is in the form of an NACA air inlet (12).

3. Cooling air supply system (10) in accordance with claim 1 or 2,
characterized in that the air channel communicating with the air inlet (12) has a diffuser (16).

4. Cooling air supply system (10) in accordance with claim 3,
characterized in that there is at least one air compressor (26), preferably a ventilator, in the diffuser (16) or in one of the first bypass lines (20) leading off from the diffuser (16).

5. Cooling air supply system (10) in accordance with claim 4,
characterized in that the air compressor (26) is electrically powered or in the form of a turbo-compressor.

6. Cooling air supply system (10) in accordance with any of the claims 3 to 5,
characterized in that a check valve (22) is provided in the diffuser (16) or in one of the second bypass lines (18) leading off from the diffuser (16), which prevents the cooling air from flowing back into the diffuser (16).

7. Cooling air supply system (10) in accordance with claim 6,
characterized in that the first bypass line (20) and the second bypass line (18) are arranged in parallel.

8. Cooling air supply system (10) in accordance with any of the claims 3 to 7,
characterized in that a cooling air collection chamber (28) joins onto the diffuser (16), preferably following the parallel arrangement of the first and second bypass line (20, 18).

9. Cooling air supply system (10) in accordance with claim 8,
characterized in that there is at least one cooling air supply line (30, 32, 34) positioned between the cooling air collection chamber (28) and each of the devices requiring cooling air (38, 44, 56).

10. Cooling air supply system (10) in accordance with one of the preceding claims,
characterized in that said throttle device is formed as a shutter.

11. Cooling air supply system (10) in accordance with any one of the previous claims,
characterized in that a pack bay ventilation system is the device requiring cooling air (38).

12. Cooling air supply system (10) in accordance with any one of the previous claims,
characterized in that an unpressurized bay ventilation system (UBV) is the device requiring cooling air (38).

13. Cooling air supply system (10) in accordance with any of the previous claims,
characterized in that an on board oxygen generation system (OBOGS) (44) is the device requiring cooling air.

14. Cooling air supply system (10) in accordance with any one of the previous claims,
characterized in that an on board inert gas generation system (OBIGGS) is the device (56) requiring cooling air.

15. Cooling air supply system (10) in accordance with any one of the previous claims,
characterized in that the device requiring cooling air, in particular the on board oxygen generation system (OBOGS) and/or the on board inert gas generation system (OBIGGS) has a heat exchanger (44, 56) which uses the cooling air in order to eliminate heat.

16. Cooling air supply system (10) in accordance with any of the previous claims,
characterized in that at least two devices requiring cooling air are connected with a common cooling air outlet (52) by means of expelled air pipes (48, 60, 50).

17. Aircraft **characterized by** a cooling air supply system (10) in accordance with any of the previous claims.

Patentansprüche

1. Kühlluft-Zufuhrsystem (10) für ein Flugzeug für das Zuführen von Kühlluft aus der Umgebung des Flugzeugs zu wenigstens zwei Kühlluft erfordernden Einrichtungen (38, 44, 56) innerhalb des Flugzeugs, mit

einem Lufteinlass (12), einem mit dem Lufteinlass (12) in Verbindung stehenden Luftkanal (16) und einer Luftverteilungseinrichtung (30, 32, 34) mit wenigstens einer Kühlluft-Zufuhrleitung (30, 32, 34) für jede der wenigstens zwei Kühlluft erfordernden Einrichtungen zur Verteilung von Luft an die wenigstens zwei Kühlluft erfordernden Einrichtungen (38, 54, 65), wobei der Lufteinlass (12) derart proportioniert ist, dass er den maximalen Kühlluftbedarf von wenigstens zwei Kühlluft erfordernden Einrichtungen (38, 44, 56) abdeckt,
dadurch gekennzeichnet, dass die Kühlluft-Zufuhrleitung (30, 32, 34) mit einer Drosseleinrichtung (36, 39, 54) ausgestattet ist.

2. Kühlluft-Zufuhrsystem (10) nach Anspruch 1, **dadurch gekennzeichnet, dass** der Lufteinlass in Form eines NACA-Lufteinlasses (12) ausgebildet ist.

3. Kühlluft-Zufuhrsystem (10) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der mit dem Lufteinlass (12) in Verbindung stehende Luftkanal einen Diffusor (16) aufweist.

4. Kühlluft-Zufuhrsystem (10) nach Anspruch 3, **dadurch gekennzeichnet, dass** wenigstens ein Luftkompressor (26), vorzugsweise ein Ventilator, in dem Diffusor (16) oder in einer der ersten, von dem Diffusor (16) weg führenden Umgehungsleitungen (20) vorgesehen ist.

5. Kühlluft-Zufuhrsystem (10) nach Anspruch 4, **dadurch gekennzeichnet, dass** der Luftkompressor (26) elektrisch angetrieben oder in der Form eines Turbo-Kompressors ausgebildet ist.

6. Kühlluft-Zufuhrsystem (10) nach einem der Ansprüche 3 bis 5,
dadurch gekennzeichnet, dass in dem Diffusor (16) oder in einer der zweiten, von dem Diffusor (16) weg führenden Umgehungsleitungen (18) ein Rückschlagventil (22) vorgesehen ist, welches die Kühlluft daran hindert, in den Diffusor (16) zurückzufließen.

7. Kühlluft-Zufuhrsystem (10) nach Anspruch 6, **dadurch gekennzeichnet, dass** die erste Umgehungsleitung (20) und die zweite Umgehungsleitung (18) parallel zueinander angeordnet sind.

8. Kühlluft-Zufuhrsystem (10) nach einem der Ansprüche 3 bis 7,
dadurch gekennzeichnet, dass eine Kühlluft-Sammelkammer (28) an dem Diffusor (16) anschließt, die vorzugsweise der parallelen Anordnung der ersten und zweiten Umgehungsleitung (20, 18) folgt.

9. Kühlluft-Zufuhrsystem (10) nach Anspruch 8, **dadurch gekennzeichnet, dass** wenigstens eine zwischen der Kühlluft-Sammelkammer (28) und jeder der Kühlluft erfordernden Einrichtungen (38, 44, 56) angeordnete Kühlluft-Versorgungsleitung (30, 32, 34) vorgesehen ist.

10. Kühlluft-Zufuhrsystem (10) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Drosseleinrichtung als eine Klappe ausgebildet ist.

11. Kühlluft-Zufuhrsystem (10) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Kühlluft erfordernde Einrichtung (38) eine Klimaraum-Belüftungseinrichtung ist.

12. Kühlluft-Zufuhrsystem (10) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Kühlluft erfordernde Einrichtung (38) eine drucklose Klimaraum-Belüftungseinrichtung (UPV) ist.

13. Kühlluft-Zufuhrsystem (10) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Kühlluft erfordernde Einrichtung eine bordeigene Sauerstofferzeugungseinrichtung (OBOGS) (44) ist.

14. Kühlluft-Zufuhrsystem (10) nach einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** die Kühlluft erfordernde Einrichtung (56) eine bordeigene Inertgas-Erzeugungseinrichtung (OBIGGS) ist.

15. Kühlluft-Zufuhrsystem (10) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Kühlluft erfordernde Einrichtung, insbesondere die bordeigene Sauerstofferzeugungseinrichtung (OBOGS) und/oder die bordeigene Inertgas-Erzeugungseinrichtung (OBIGGS), einen Wärmetauscher (44, 56) aufweist, welcher die Kühlluft verwendet, um Wärme abzuleiten.

16. Kühlluft-Zufuhrsystem (10) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** wenigstens zwei Kühlluft erfordernde Einrichtungen mittels Abluftrohren (48, 60, 50) mit einem gemeinsamen Kühlluft-Auslass (52) verbunden sind.

17. Flugzeug, **gekennzeichnet durch** ein Kühlluft-Zufuhrsystem (10) nach einem der vorangehenden Ansprüche.

Revendications

1. Système d'alimentation en air de refroidissement (10) pour un aéronef pour l'alimentation en air de refroidissement depuis les alentours de l'aéronef vers au moins deux dispositifs nécessitant de l'air de refroidissement (38, 44, 56) à l'intérieur de l'aéronef, avec un orifice d'entrée d'air (12), un canal d'air (16) communiquant avec l'orifice d'entrée d'air (12) et un dispositif de répartition de l'air (30, 32, 34) avec au moins une conduite d'alimentation en air de refroidissement (30, 32, 34) pour chacun des au moins deux dispositifs nécessitant de l'air de refroidissement pour la répartition de l'air vers les au moins deux dispositifs nécessitant de l'air de refroidissement (38, 44, 56), d'où il résulte que l'orifice d'entrée d'air (12) est proportionné d'une manière telle qu'il couvre l'exigence en air de refroidissement maximale des au moins deux dispositifs nécessitant de l'air de refroidissement (38, 44, 56),
caractérisé en ce que la conduite d'alimentation en air de refroidissement (30, 32, 34) est munie d'un dispositif d'étranglement (36, 39, 54).

2. Système d'alimentation en air de refroidissement (10) selon la revendication 1,
caractérisé en ce que l'orifice d'entrée d'air se présente sous la forme d'un orifice d'entrée d'air NACA (12).

3. Système d'alimentation en air de refroidissement (10) selon la revendication 1 ou 2,
caractérisé en ce que le canal d'air communiquant avec l'orifice d'entrée d'air (12) possède un diffuseur (16).

4. Système d'alimentation en air de refroidissement (10) selon la revendication 3,
caractérisé en ce qu'il se trouve au moins un compresseur d'air (26), de préférence un ventilateur, dans le diffuseur (16) ou dans l'une des premières conduites de dérivation (20) commençant depuis le diffuseur (16).

5. Système d'alimentation en air de refroidissement (10) selon la revendication 4,
caractérisé en ce que le compresseur d'air (26) est alimenté de manière électrique ou sous la forme d'un turbocompresseur.

6. Système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications 3 à 5,
caractérisé en ce qu'un clapet de non-retour (22) est prévu dans le diffuseur (16) ou dans l'une des deuxièmes conduites de dérivation (18) commençant depuis le diffuseur (16), qui empêche l'air de refroidissement de circuler en retour dans le diffuseur (16).

7. Système d'alimentation en air de refroidissement (10) selon la revendication 6,
caractérisé en ce que la première conduite de dérivation (20) et la deuxième conduite de dérivation (18) sont disposées de manière parallèle.

8. Système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications 3 à 7,
caractérisé en ce qu'une chambre de collecte d'air de refroidissement (28) se raccorde sur le diffuseur (16), de préférence en suivant la disposition parallèle des première et deuxième conduites de dérivation (20, 18).

9. Système d'alimentation en air de refroidissement (10) selon la revendication 8,
caractérisé en ce qu'il se trouve au moins une conduite d'alimentation en air de refroidissement (30, 32, 34) positionnée entre la chambre de collecte d'air de refroidissement (28) et chacun des dispositifs nécessitant de l'air de refroidissement (38, 44, 56).

10. Système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications précédentes,
caractérisé en ce que ledit dispositif d'étranglement est formé comme un volet.

11. Système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications précédentes,
caractérisé en ce qu'un système de ventilation de modules de groupe est le dispositif nécessitant de l'air de refroidissement (38).

12. Système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications précédentes,
caractérisé en ce qu'un système de ventilation de modules sans pressurisation (UBV) est le dispositif nécessitant de l'air de refroidissement (38).

13. Système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications précédentes,
caractérisé en ce que le système de génération d'oxygène embarqué (OBOGS) (44) est le dispositif nécessitant de l'air de refroidissement.

14. Système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications précédentes,
caractérisé en ce que le système de génération de gaz inertes embarqué (OBIGGS) est le dispositif (56) nécessitant de l'air de refroidissement.

15. Système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications précédentes,
caractérisé en ce que le dispositif exigeant de l'air de refroidissement, en particulier le système de génération d'oxygène embarqué (OBOGS) et/ou le système de génération de gaz inertes embarqué (OBIGGS) comporte un échangeur de chaleur (44, 56) qui utilise l'air de refroidissement afin d'éliminer la chaleur.

16. Système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications précédentes,
caractérisé en ce qu'au moins deux dispositifs nécessitant de l'air de refroidissement sont raccordés à un orifice de sortie (52) d'air de refroidissement commun au moyen de tuyaux d'air refoulé (48, 60, 50).

17. Aéronef **caractérisé par** un système d'alimentation en air de refroidissement (10) selon l'une quelconque des revendications précédentes.

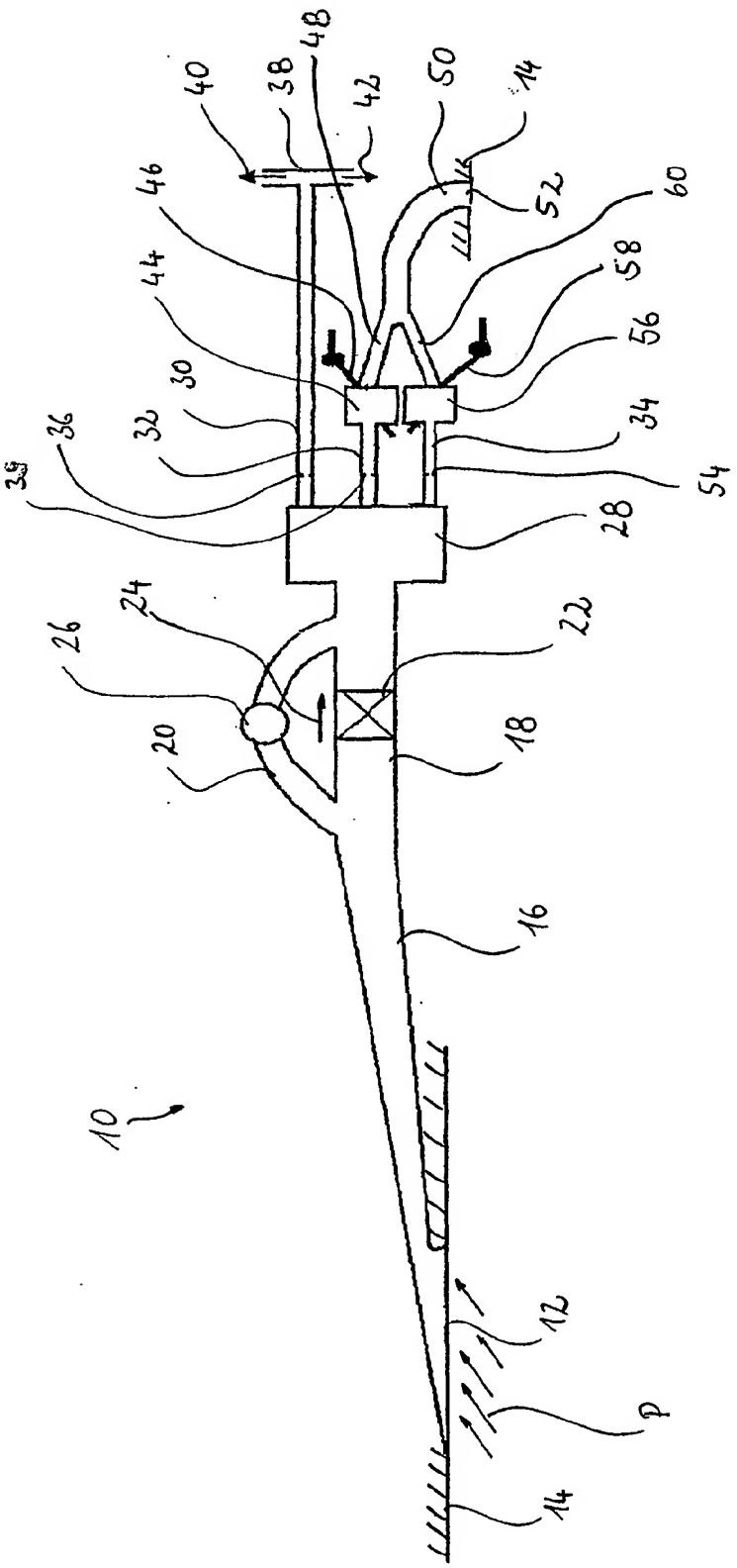
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Fig.

REFERENCES CITED IN THE DESCRIPTION

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- US 20021166923 A1 **[0004]**